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# **GEOLOGICAL AND PETROPHYSICAL CHARACTERIZATION OF THE FERRON SANDSTONE FOR 3-D SIMULATION OF A FLUVIAL-DELTAIC RESERVOIR**

(Contract No. DE-AC22-93BC14896)

Utah Geological Survey (UGS), Salt Lake City, Utah 84114

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## **Objective**

The objective of this project is to develop a comprehensive, interdisciplinary, and quantitative characterization of a fluvial-deltaic reservoir which will allow realistic inter-well and reservoir-scale modeling to be constructed for improved oil-field development in similar reservoirs world-wide. The geological and petrophysical properties of the Cretaceous Ferron Sandstone in east-central Utah will be quantitatively determined. Both new and existing data will be integrated into a three-dimensional representation of spatial variations in porosity, storativity, and tensorial rock permeability at a scale appropriate for inter-well to regional-scale reservoir simulation. Results could improve reservoir management through proper infill and extension drilling strategies, reduction of economic risks, increased recovery from existing oil fields, and more reliable reserve calculations. Transfer of the project results to the petroleum industry is an integral component of the project.

## **Summary of Technical Progress**

Two activities continued this quarter as part of the geological and petrophysical characterization of the fluvial-deltaic Ferron Sandstone: (1) preparation of the project final report and (2) technology transfer.

### ***Project Final Report***

The final report, which summarizes the research results of the Ferron Sandstone project, is being prepared. The report will include chapters on the: (1) regional stratigraphy, (2) Ferron facies, (3) geological framework of the Ivie Creek and Willow Springs Wash case-study areas, (4) petrophysics and statistical analysis of the Ferron reservoir facies in the Ivie Creek case-study area, and (5) fluid-flow model of the river-dominated Kf-1-Ivie Creek-a parasequence as a reservoir analog. Cross sections, paleogeographic maps, interpreted photomosaics, measured sections, and permeability and other raw data produced as project deliverables or collected during the course of the project and referred to in the report, will be released by the Utah Geological Survey (UGS) as open-file or contract reports.

### ***Technology Transfer***

The UGS and its partners presented results of the project to the petroleum industry at a three-day field trip and one-day short course during the American Association of Petroleum Geologists (AAPG) annual national meeting in Salt Lake City, Utah, May 17-20, 1998. The field trip and short course were sponsored by the UGS, National Petroleum Technology Office - DOE, Mobil Technology Company, and Amoco Production Company. Field guidebooks and course notes were provided to the 37 attendees.

The pre-meeting field trip titled *Stratigraphic Framework for Reservoir Modeling in Fluvial-Deltaic Deposits: A Parasequence-level Analysis and Reservoir Characterization of the Ferron Sandstone, Utah*, was held on May 14-16, 1998 (Fig. 1). The first day of the trip involved an overview of the Ferron coalbed methane play and an introduction to the Ferron outcrops at Dry Wash. Dry Wash outcrops exhibit a variety of shoreline and fluvial depositional styles. The entire second day was spent examining shoreface and delta-front deposits within three parasequences of the Kf-1 parasequence set in exposures along the walls of Indian Canyon. Most of the third day was spent on outcrops north of Ivie Creek. The Kf-1 there includes river-dominated deltaic deposits in a well-defined subdelta lobe. Overlying shoreface and wave-dominated deposits of Kf-2 were also examined. Prior to the trip, permeability values were marked on the outcrops by the field trip leaders along sections traversed by the group.

The short course titled *Core and Reservoir Modeling Workshop: Fluvial-Deltaic Nearshore Sands of Ferron Sandstone* was held on May 17, 1998. The course took the participants from outcrop to reservoir modeling and flow simulation results of the Ferron project. The course began with a brief review of the field stops and geologic setting. The morning was devoted to examining core, corresponding geophysical logs, and core permeability data to identify sand trends/facies, relate facies to permeability, and classify bounding surfaces. Correlation exercises helped participants understand the challenges involved in working with a subsurface data set, while enjoying the benefit

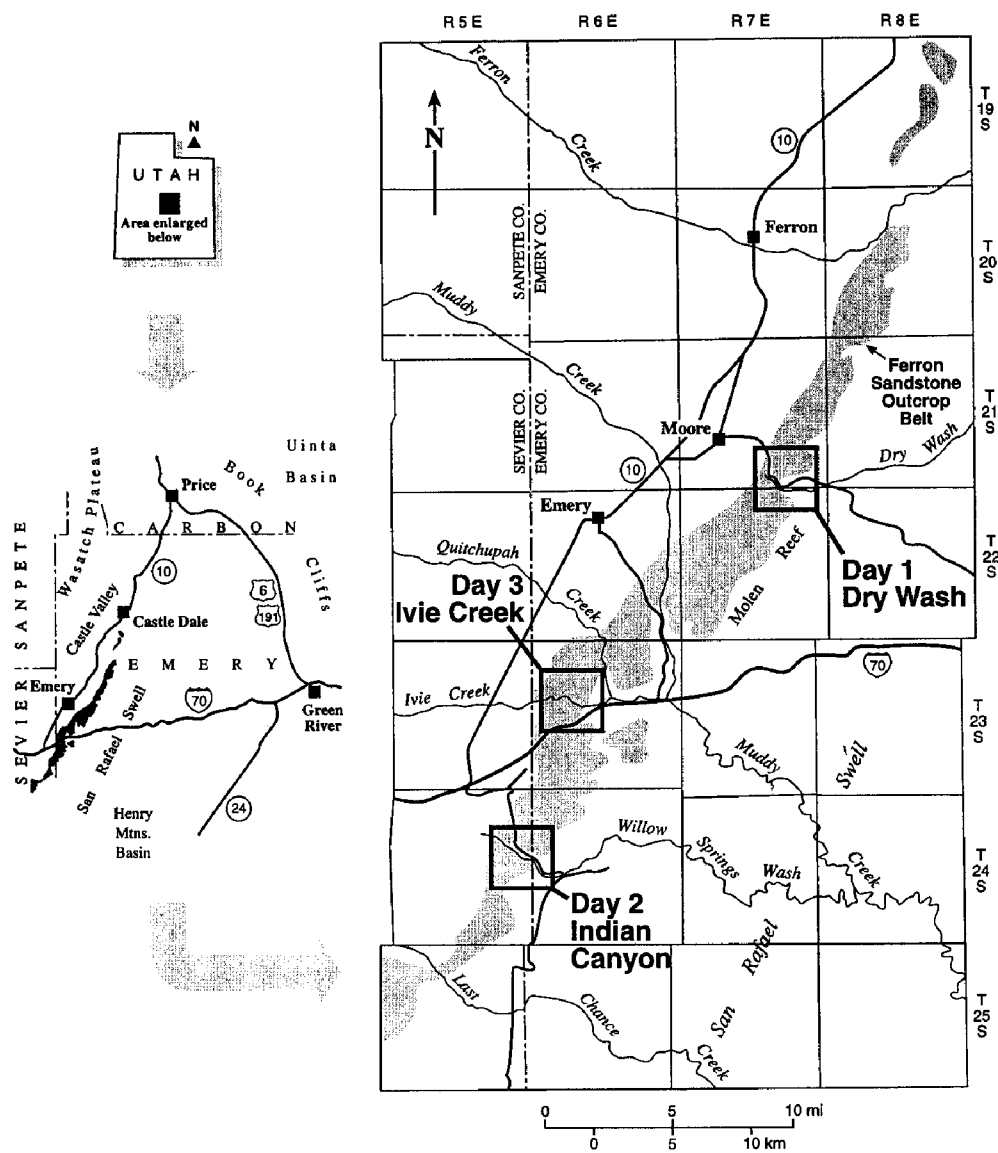


Fig. 1. Location map showing: the portion of the Ferron Sandstone outcrop belt (shaded) and American Association of Petroleum Geologists annual meeting field trip hike locations.

of three-dimensional outcrop exposures. In the afternoon, methods were outlined to quantify the outcrop data, build two- and three-dimensional petrophysical models, and simulate different reservoir production scenarios. Petrophysical and architectural data collected at the Ferron Sandstone study site were incorporated in project reservoir simulations that will aid in exploring the impact of clinoform architecture on fluid flow through a fluvial-dominated deltaic deposit. The simulation results provide direct insight into the way features observed in outcrop might influence reservoir production strategies. The detailed simulation models presented during the course also provide a basis for evaluating how such features might be treated in the upscaling methods needed to create the coarser simulation grids used in evaluating reservoir performance.

Project material was displayed at the UGS booth during the AAPG annual convention. Ferron team members presented a paper describing reservoir modeling and flow simulation of the Ferron Sandstone at the convention.<sup>1</sup> The project home page on the UGS Internet web site (<http://www.ugs.state.ut.us/paradox.htm>) was updated with the latest quarterly technical report and project publications list.

## **Reference**

1. S. H. Snelgrove, Ann Mattson, C. B. Forster, M. A. Chan, and P. B. Anderson, From Outcrop to Simulation in the Ferron Sandstone - Integrated Characterization of a Fluvial-Dominated Delta-Front Reservoir Analog [abs.]: *Amer. Assoc. of Petrol. Geol. Annual Convention, Extended Abstracts II*: A616 (1998).